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# ANN-based ensemble model for predicting micro-EDM responses and machining variability

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## Abstract

Micro-electrical discharge machining ( $\mu$ EDM) requires high precision, quality and efficiency, yet machinists rely heavily on expertise and heuristics due to the complexity of the process and the use of machining different materials. This article introduces the use of artificial neural networks (ANNs) and ensemble models to predict key  $\mu$ EDM responses, such as machining time (MT), tool wear rate (TWR), overcut (OC) and taper angle (TA). The model incorporates material properties like thermal conductivity, melting point and electrical resistivity, along with input factors, including capacitance, voltage, feed rate, tool speed, tool diameter and workpiece type. Experimental data, collected using an I-optimal design of experiments (DOE) technique, was used to train the ANN models and optimized through grid search. The model's accuracy, evaluated across training, testing and validation sets, showed mean

accuracies between 76.84% and 86.62%. Deployment results revealed strong alignment between experimental and predicted outcomes, with predictions within a four standard deviation ( $4\sigma$ ) range. A user-friendly graphical interface (GUI) facilitates the prediction process, improving precision and decision-making in  $\mu$ EDM for various workpieces. © 2025 Taylor & Francis Group, LLC.

## Author keywords

ANN; grid-search-optimization; machining variability; micro-EDM; model averaging

## Indexed keywords

### Engineering controlled terms

Cutting tools; Machining centers; Micromachining; Prediction models

### Engineering uncontrolled terms

Artificial neural network modeling; Ensemble models; Grid search; Grid-search-optimization; Machining variability; Micro EDM; Model averaging; Neural-networks; Search optimization; Workpiece

### Engineering main heading

Electric discharge machining

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